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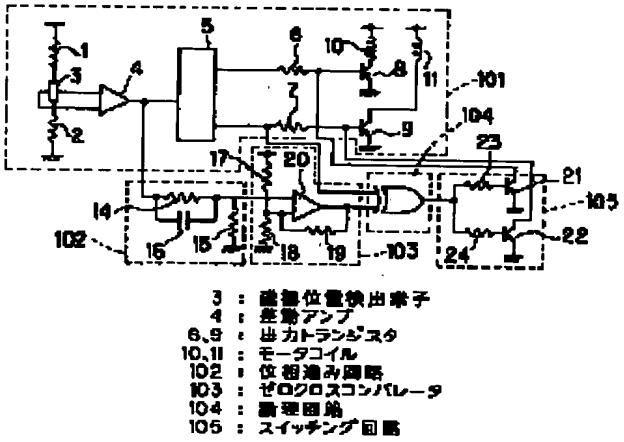
(54)【発明の名称】モータの制御回路

(57)【要約】
【課題】　モータの騒音及びスイッチングノイズを低減させ、効率の向上を図るようにしたファンモータ用等に好適なモータの制御回路を提供する。
【解決手段】　出力トランジスタ８、９のオン、オフによって、モータコイル１０、１１に周期的に電流を流してロータを回転させるモータの制御回路において、ロータの回転に応じて信号を出力する磁極位置検出素子３と、この磁極位置検出素子３の信号を増幅する差動アンプ４と、この差動アンプ４の出力の位相を進める位相進み回路１０２と、この位相進み回路１０２の出力をパルスに変換するゼロクロスコンパレータ１０３と、ゼロクロスコンパレータ１０３の位相進み量を検出する論理回路１０４と、論理回路１０４の出力により、各周期毎にモータコイル１０、１１の通電電流の末期を遮断するよう出力トランジスタ８、９をオフする回路（１０５）とを備えて構成した。



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【特許請求の範囲】

【請求項１】出力トランジスタのオン、オフによってモータコイルに周期的に電流を流してロータを回転させるモータの制御回路において、

ロータの回転に応じて信号を出力する磁極位置検出素子と、この磁極位置検出素子の信号を増幅する差動アンプと、この差動アンプの出力の位相を進める位相進み回路と、この位相進み回路の出力をパルスに変換するゼロクロスコンパレータと、前記ゼロクロスコンパレータの位相進み量を検出する論理回路と、前記論理回路の出力により、各周期毎に上記モータコイルの通電電流の末期を遮断するように上記出力トランジスタをオフとする回路とを備えたことを特徴とするモータの制御回路。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明はファン駆動用等に使用されるＤＣブラシレスモータ等のモータの制御に有用なモータの制御回路の改良に関する。

【０００２】

【従来の技術】例えば、ＤＣブラシレスファン駆動用等の用途に使用されるモータは、限られたスペースの中に、そのモータの制御回路を収納する必要があるため小型であることと、低コストで製作できることが求められている。そのため、この種のモータの制御回路では、回路部品が少なくてすむ方式として、１個の磁極位置検出素子でロータの位置検出を行い、この信号で２個の出力トランジスタを切り替える１８０度位相差の２相半波駆動が一般的に採用されている。図６は、従来のこの種の用途に用いられるＤＣブラシレスモータの制御回路の接続図である。同図において、１及び２は夫々バイアス抵抗、３はロータの磁極位置を検出する磁極位置検出素子で、例えばホール素子が用いられる。４は磁極位置検出素子３の出力を増幅する差動アンプである。５は分配回路で、差動アンプ４の出力信号によってモータコイル１０、１１のいずれかに通電するかを決める相補の通電指令信号を出力する。このため、分配回路５の通電指令信号を抵抗６及び７を介して出力トランジスタ８及び９をオン（オフ）することで、モータコイル１０及び１１に通電（通電停止）する。以上の１乃至１１で従来のモータの制御回路１０１が構成される。図７は上記従来の制御回路による動作タイミングチャートを示すものである。同図において、（ａ）はロータの回転に伴う磁極位置検出素子３による２つの出力を示し、同図に示すように、ホール素子ＤＣバイアス電圧に対して出力が交互にハイレベルになる。（ｂ）は差動アンプ４の出力、（ｃ）及び（ｄ）は夫々分配回路５の出力信号である。（ｅ）及び（ｆ）は夫々モータコイル１０及び１１の通電電流であり、各周期の末期に通電電流が大きくなっていて、前述したように騒音、モータ効率が悪化している。（ｇ）及び（ｈ）は夫々出力トランジスタ８及び９

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のコレクタ電圧波形であり、大きな通電電流が遮断された際に、Ｌ（ｄｉ／ｄｔ）による大きなサージ電圧が発生している様子が示されている。

【０００３】

【発明が解決しようとする課題】上記のように、従来のものでは、モータコイルの駆動電流は図７の（ｅ）、（ｆ）に示すように、各モータコイルの通電の末期ではモータ逆起電圧が小さくなるため駆動電流が大きくなってしまう。ところで、この末期の電流は急峻であるため騒音の原因となり、モータコイルには同図の（ｇ）及び（ｈ）のように大きなサージ電圧も発生する。また、この末期電流はモータの発生トルクに寄与しないため効率を著しく劣化させる原因となっている。そこで、この点を改善する先行技術として、特開平６－２４５５８４号公報等で示すように、回転に対応する周期毎にモータコイルに通電する電流の末期を周期に比例したデューティで遮断する回路が提案されている。しかしながら、この先行技術のものでは、モータコイルに対する通電の末期を遮断することは通電角が電気的に１８０度でなくなっていて、２相コイルの発生トルクの和が零である位置の範囲が広がる。この現象は電源投入や信号によるモータ起動の際に起動できないデッドポイントが存在することになる。この対策のために、さらに起動時のみ１８０度通電とする起動補償回路を追加したり、モータ起動位置を磁気力で決めるためのリラクタンストルクを大きくすることが必要となるが、コストアップや性能劣化を伴うという問題点があった。本発明は従来のものの上記課題（問題点）を解決し、相切り替え時のスイッチングパルスの低減とモータの効率向上を図るようにしたモータの制御回路を提供することを目的とする。

【０００４】

【課題を解決するための手段】本発明のモータの制御回路は、上記課題を解決するために、磁極位置検出素子の出力を増幅し、これが正弦波状であることを利用して、回転数が高くなるに従い、ある位相まで、位相が進む位相進み回路を設け、その出力をゼロクロスコンパレータでパルス信号として入力し、他方の入力信号であるコイル通電指令（１８０度通電）信号とで論理回路により両者の位相差の時間だけ遮断パルスを発生させて、コイル電流の通電末期を遮断するように構成した。

【０００５】上述のような構成にすると、モータ起動時の位相進み回路の出力とコイル通電指令信号の位相差は零となり、遮断パルスは発生しない。モータの回転数が上昇するに従い磁極位置検出素子の出力の周波数が高くなり、徐々に位相進み回路の位相が進むため遮断パルスの幅が長くなり、定格回転数で所定の遮断パルス幅となる。その遮断パルス幅で通電末期のモータコイルの電流が遮断される。また、定格回転数で運転中に何らかの原因で回転数が低下すると、位相進み回路の進み量が減少して遮断パルス幅が短くなり、モータコイルの電流の通

電末期の遮断量が減り電流は増加する。また、逆に回転数が高くなると電流は減少する。その結果、モータは若干加速したり、減速したりすることで一定回転数を保つような速度制御ループが形成される。

【０００６】

【発明の実施の形態】以下、２相のＤＣブラシレスモータに適用した図１に示す一実施の形態により本発明を具体的に説明する。本発明のモータの制御回路は、同図に示すように、従来の制御回路１０１に対して、位相進み回路１０２、ゼロクロスコンパレータ１０３、論理回路１０４及びスイッチング回路１０５を追加して構成したものである。従って、従来のものと同等の構成については、図６と同一の符号を付して、その説明は省略する。次に、この追加された構成について説明する。位相進み回路１０２は、抵抗１４、１５及びコンデンサ１６から成り、同図に示すように差動アンプ４の出力が入力するが、この入力信号は正弦波状となっていて、位相進み回路１０２により差動アンプ４の出力周波数（ホール素子出力周波数）に合わせて、所定の位相だけ進む。図２は位相進み回路１０２の周波数と位相の関係を示すもので、定格回転数で位相進み角が（ｊ）点のようにピーク値手前となるよう抵抗１４、１５及びコンデンサ１６の定数が設定されている。ゼロクロスコンパレータ１０３は、オペアンプ２０、基準電圧用抵抗１７、１８とヒステリシス用抵抗１９から成る。基準電圧は位相進み回路１０２の出力の振幅中心電圧となるように抵抗１７、１８の分圧で決められる。これにより、位相進み回路１０２の出力は振幅の中心でパルス状に変換されるためゼロクロスコンパレータと称する。ゼロクロスでパルスに変換する理由は、ホール素子の温度特性、回路バラツキ等で位相進み回路１０２の出力が変化することが考えられるためである。論理回路１０４は、一致回路で分配回路５の通電指令信号の一方と、ゼロクロスコンパレータ１０３の信号を比較して、両者が一致していない時ハイレベルの信号パルスを発生する。その信号パルスを、以下遮断パルスと称する。スイッチング回路１０５は、トランジスタ２１、２２及び抵抗２３、２４より構成され、論理回路１０４から発生する遮断パルスでトランジスタ８及び９の通電を遮断するものである。

【０００７】図３は本発明による動作タイミングチャートである。同図において（ｂ）は差動アンプ４の出力、（ｋ）は位相進み回路１０２の出力、（Ｌ）はゼロクロスコンパレータ１０３の出力である。（ｍ）は分配回路５の通電指令信号の一方、（ｎ）は論理回路１０４の出力で通電末期の遮断パルスとなる。（p_1）及び（p_2）は夫々モータコイル１０及び１１の通電電流で、その内（p_1）は立ち上がりに（ｍ）に示す分配回路５の一方の信号に同期し、立ち下がりに通電電流が大きくなる前で（ｎ）に示す論理回路１０４の信号に同期し遮断される。このように、モータコイル１０及び１１の通電末期が遮断され、トルクに無効な電流をカットすることによりモータの効率が向上する。（ｑ）及び（ｒ）は夫々出力トランジスタ８及び９のコレクタ電圧であり、通電末期の大きな電流が遮断されモータコイル１０及び１１に蓄積されるエネルギーが小さくなるため、通電遮断時のサージ電圧が減少している。

【０００８】ここで、起動時から定格回転数まで回転が上昇する際の遮断パルスのパルス幅変化について説明する。起動時は、回転数が零から徐々に上昇するため、位相進み回路１０２の出力位相は図２において、周波数が低い場合であり、進みはほとんどない。回転数が定格に近づくにつれて位相が進み、遮断パルスが発生し、徐々にパルス幅が大きくなり、モータ通電角と対応する定格回転数に到達する。即ち、起動時は通電角は遮断されることなく、デッドポイントの発生範囲も大きくはならない。この起動時の動作を図４のタイミングチャートで示す。同図において、（ｔ）は起動時の差動アンプ４の出力、（ｕ）は分配回路５の通電指令信号の一方、（ｖ）はゼロクロスコンパレータ１０３の出力、（ｗ）は論理回路１０４の出力であり、遮断パルス幅が回転数の増加に伴い、増加していることがわかる。また、回転数に応じて遮断パルスのパルス幅が変化する効果により、外乱によるモータの回転数変動に対して、回転が遅くなれば遮断パルス幅が狭くなり、通電電流は増加しモータは加速される。また、回転が早くなると遮断パルス幅は広くなり、通電電流は減少しモータは減速されることで、速度制御ループも形成されることになる。図５は、この状態を表わすタイミングチャートである。同図において、（ｘ）は差動アンプ４の出力、（ｙ）は遮断パルスで、回転数が定格の場合、遅い場合及び早い場合を夫々示したものである。

【０００９】本発明は上記の実施例のものに限定されるものではない。例えば、上記実施例では本発明を２相のＤＣブラシレスモータに適用する場合で説明したが、３相又は５相等の他の多相のＤＣブラシレスモータにも適用可能である。その場合は、例えば、３相のＤＣブラシレスモータに適用する場合には、スター接続又はデルタ接続された３相の３個のモータコイルに対応するように、分配回路５の出力端子を３つ、出力トランジスタも３個及びスイッチング回路１０５内のスイッチング用のトランジスタを３個、夫々設けて図１の２相の場合に準じて接続すれば良い。また、上記実施例では、ゼロクロスコンパレータ１０３をオペアンプ２０、基準電圧用抵抗１７、１８及びヒステリシス抵抗１９で構成した場合を示したが、このような比較機能を備えた他の論理素子で構成しても良い。

【００１０】

【発明の効果】上記のように本発明のモータの制御回路では、位相進み回路を使用して、ゼロクロスコンパレータにより遮断パルス幅を確実に可変できるようにしたか

ら、次のような優れた効果を有する。

（１）モータの起動時から定格回転数まで自動的に通電末期の遮断時間を可変することができる。

（２）その結果、モータの起動を円滑に行うことができるから騒音は抑制され、相切り替え時のスイッチングパルスを低減できるから、モータの効率は大幅に向上する。

（３）しかも、本発明の制御回路は簡易であり、電子部品数が少なく、温度変化、電子部品バラツキ等による影響が少ない。

（４）また、ＩＣ化も可能であり小型、低コスト化も達成されるから、ＤＣブラシレスファンの駆動用モータのほか、小型、コンパクトな状態で収納されることを要求される各種用途のモータの制御回路として実用性が大である。

【図面の簡単な説明】

【図１】本発明の一実施の形態に係わるモータの制御回路の構成を示す接続図である。

【図２】本発明の構成中の位相進み回路の周波数特性図である。

【図３】本発明の制御回路による動作タイミングチャートである。

【図４】本発明による起動時の動作タイミングチャートである。

【図５】本発明によるモータ回転数変化時の動作タイミングチャートである。

【図６】従来のモータの制御回路の構成を示す接続図である。

【図７】従来のモータの制御回路による動作タイミングチャートである。

【符号の説明】

３：磁気位置検出素子

４：差動アンプ

８、９：出力トランジスタ

１０、１１：モータコイル

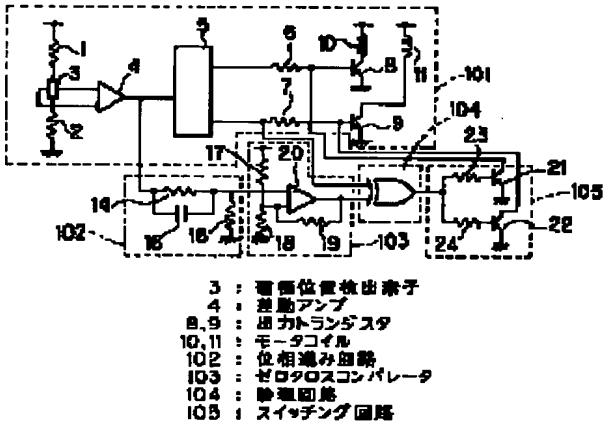
１０２：位相進み回路

１０３：ゼロクロスコンパレータ

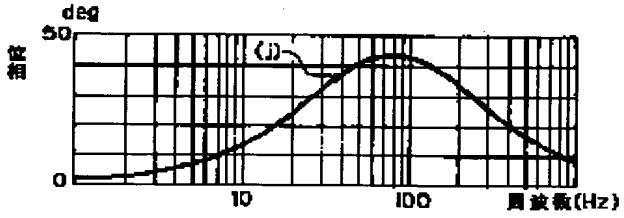
１０４：論理回路

１０５：スイッチング回路

【図１】

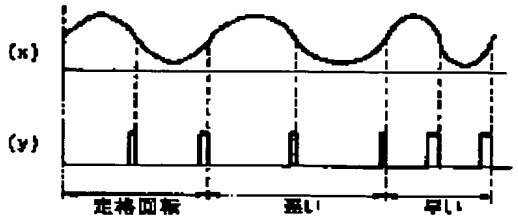


【図２】

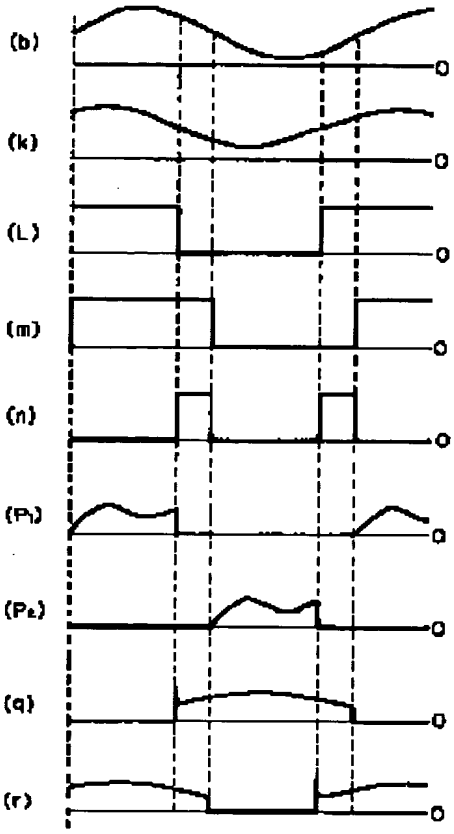


【図４】

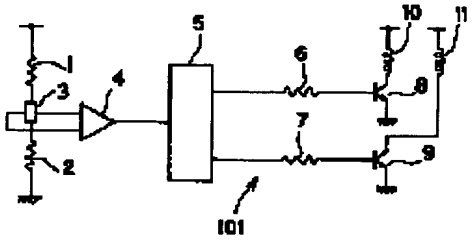
【図５】



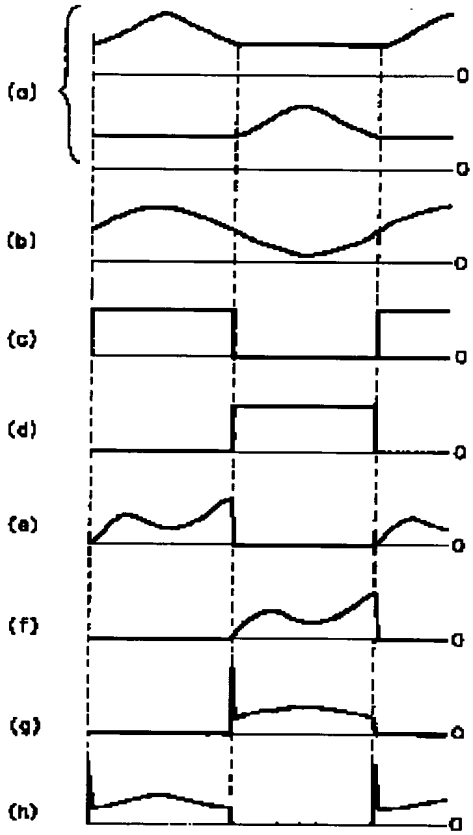
【図３】



【図６】



【図７】



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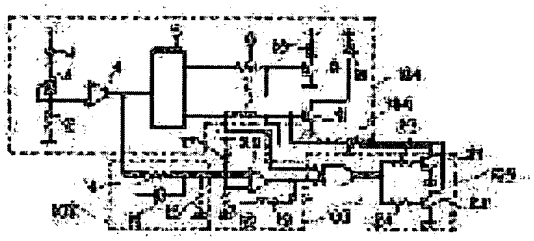
(72)Inventor : **OIWA SHOJI**

(54) MOTOR CONTROL CIRCUIT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a motor control circuit for enhancing the efficiency of a fan motor or the like while reducing the motor noise and switching noise.
SOLUTION: The motor control circuit for rotating a rotor by turning output transistors 8, 9 on/off to feed a current periodically to motor coils 10, 11 comprises a pole position detection element 3 for outputting a signal depending on the rotation of rotor, a differential amplifier 4 for amplifying the output signal from pole position detection element 3, a circuit 102 for advancing the phase of output from the differential amplifier 4, and a zero-cross comparator 103 for converting the output from phase lead circuit 102 into a pulse. The motor control circuit further comprises a logic circuit 104 for detecting the phase lead of zero-cross comparator 103, and a circuit 105 for turning the output transistors 8, 9 on/off to interrupt the conduction current of motor coil 10, 11 at the final stage of each period using the output from the logic circuit 104.



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Summary

(57) [Abstract]
[Technical problem] The noise and the switching noise of a motor are reduced and the control circuit of the suitable motor for the fan motors which aimed at improvement in efficiency is offered.
[Means for Solution] The magnetic pole position sensing element 3 which outputs a signal according to rotation of Rota in the control circuit of a motor which current is periodically passed [control circuit] in the motor coils 10 and 11, and makes them rotate Rota by ON of the output transistors 8 and 9, and OFF, The differential amplifier 4 which amplifies the signal of this magnetic pole position sensing element 3, and the phase lead network 102 which advances the phase of the output of this differential amplifier 4, By the output of the zero cross comparator 103 which changes the output of this phase lead network 102 into a pulse, the logical circuit 104 which detects the amount of phase lead lag networks of the zero cross comparator 103, and a logical circuit 104 The circuit (105) which turns off the output transistors 8 and 9 so that the last stage of the energization current of the motor coils 10 and 11 may be intercepted for every period was had and constituted.

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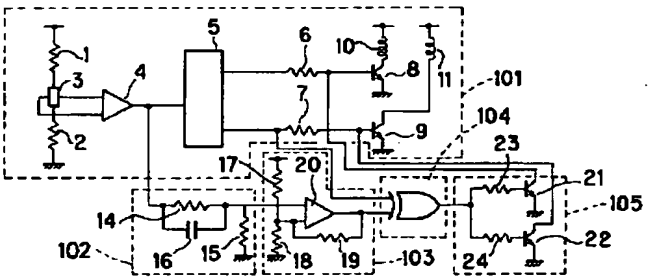

3 : 磁極位置検出素子
4 : 差動アンプ
8、9 : 出力トランジスタ
10、11 : モータコイル
102 : 位相遅み回路
103 : ゼロクロスコンパレータ
104 : 論理回路
105 : スイッチング回路

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CLAIMS

[Claim(s)]

[Claim 1] The ON of an output transistor, the control circuit of a motor which current is periodically passed [control circuit] in a motor coil and makes it rotate Rota by OFF characterized by providing the following The magnetic pole position sensing element which outputs a signal according to rotation of Rota Differential amplifier which amplifies the signal of this magnetic pole position sensing element The phase lead network which advances the phase of the output of this differential amplifier The zero cross comparator which changes the output of this phase lead network into a pulse, the logical circuit which detects the amount of phase lead lag networks of the aforementioned zero cross comparator, and the circuit which makes the above-mentioned output transistor off by the output of the aforementioned logical circuit so that the last stage of the energization current of the above-mentioned motor coil may be intercepted for every period

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to improvement of the control circuit of a motor useful to control of motors, such as DC brushless motor used for a fan drive.
[0002]
[Description of the Prior Art] For example, it is called for that it is small since the motor used for the uses for DC brush loess fan drive etc. needs to contain the control circuit of the motor in the limited space, and that it can manufacture by the low cost. Therefore, generally in the control circuit of this kind of motor, 2 phase half-wave drive of 180-degree phase contrast which performs position detection of Rota by one magnetic pole position sensing element, and changes two output transistors by this signal as a method with which there are few passive circuit elements and they end is adopted. Drawing 6 is a connection diagram of the control circuit of DC brushless motor used for this conventional kind of use. In this drawing, it is the magnetic pole position sensing element to which 1 and 2 detect bias resistance and 3 detects the magnetic pole position of Rota, for example, a hall device is used, respectively. 4 is differential amplifier which amplifies the output of the magnetic pole position sensing element 3. 5 outputs the energization command signal of the complementation which is a distribution circuit and decides whether to energize to either of the motor coils 10 and 11 by the output signal of the differential amplifier 4. For this reason, the energization command signal of the distribution circuit 5 is energized in the motor coils 10 and 11 by turning on the output transistors 8 and 9 through resistance 6 and 7 (OFF) (energization halt). The control circuit 101 of the motor conventional by 1 of a more than or 11 is constituted. Drawing 7 shows the timing chart of operation by the above-mentioned conventional control circuit. In this drawing, as (a) shows two outputs by the magnetic pole position sensing element 3 accompanying rotation of Rota and shows them in this drawing, an output becomes high-level by turns to hall device DC-bias voltage. The output of the

differential amplifier 4, (c), and (d) of (b) are the output signals of the distribution circuit 5, respectively. (e) And (f) is energization current of the motor coils 10 and 11, respectively, and as energization current is large and being mentioned above in the last stage of each period, noise and the motor efficiency are getting worse. (g) And (h) is the collector-voltage wave of the output transistors 8 and 9, respectively, and when big energization current is intercepted, signs that the big surge voltage by L (di/dt) has occurred are shown.

[0003]

[Problem(s) to be Solved by the Invention] As mentioned above, in the conventional thing, as the drive current of a motor coil is shown in (e) of drawing 7 , and (f), since a motor reverse electromotive voltage becomes small, in the last stage of energization of each motor coil, drive current will become large. By the way, since the current of this last stage is steep, it becomes the cause of noise, and in a motor coil, big surge voltage is also generated like (g) of this drawing, and (h). Moreover, this terminal current is the cause of degrading efficiency remarkably in order not to contribute to the generating torque of a motor. Then, as advanced technology which improves this point, as JP,6-245584,A etc. shows, the circuit which intercepts the last stage of the current corresponding to rotation energized in a motor coil for every period by the duty proportional to the period is proposed. However, in the thing of this advanced technology, as for intercepting the last stage of the energization to a motor coil, the range of the position whose sum of the generating torque of 2 phase coil the energization angle has stopped being 180 degrees electrically, and is zero spreads. The dead point which cannot start this phenomenon in the case of motor starting by powering on or the signal will exist. Although the starting compensating circuit which considers only during starting as energization 180 degrees further for this cure was added or it was necessary to enlarge reluctance torque for deciding a motor starting position by the magnetic force, there was a trouble of being accompanied by a cost rise or performance degradation. this invention solves the above-mentioned technical problem (trouble) of the conventional thing, and it aims at offering reduction of the switching pulse at the time of a phase change, and the control circuit of a motor which aimed at improvement in efficiency of a motor.

[0004]

[Means for Solving the Problem] As it amplifies the output of a magnetic pole position sensing element and a rotational frequency becomes high using this being a sine wave-like, in order that the control circuit of the motor of this invention may solve the above-mentioned technical problem to a certain phase Prepare the phase lead network to which a phase progresses, and the output is inputted as a pulse signal with a zero cross comparator. Only the time of both phase contrast generated the interception pulse by the logical circuit by the coil energization instruction (180-degree energization) signal which is an input signal of another side, and it constituted so that the energization last stage of coil current might be intercepted.

[0005] With the above composition, the output of the phase lead network of motor during starting and the phase contrast of a coil energization command signal serve as zero, and an interception pulse is not generated. In order that the frequency of the output of a magnetic pole position sensing element may become high and the phase of a phase lead network may progress gradually as the rotational frequency of a motor rises, the width of face of an interception pulse becomes long, and turns into interception pulse width predetermined with a nominal speed. The current of the motor coil of the energization last stage is intercepted by the interception pulse width. Moreover, if a rotational frequency falls by a certain cause on stream with a nominal speed, the amount of leads of a phase lead network will decrease, interception pulse width will become short, the amount of interception of the energization last stage of the current of a motor coil will become less, and current will increase. Moreover, if a rotational frequency becomes high conversely, current will decrease. Consequently, a speed-control loop which maintains a fixed rotational frequency by accelerating a motor a little or slowing down is formed.

[0006]

[Embodiments of the Invention] The gestalt of 1 operation hereafter shown in drawing 1 applied to DC brushless motor of two phases explains this invention concretely. The control circuit of the motor of this invention adds and constitutes a phase lead network 102, the zero cross

comparator 103, a logical circuit 104, and a switching circuit 105 to the conventional control circuit 101, as shown in this drawing. Therefore, about composition equivalent to the conventional thing, the same sign as drawing 6 is attached and the explanation is omitted. Next, this added composition is explained. Although the output of the differential amplifier 4 inputs as a phase lead network 102 consists of resistance 14 and 15 and a capacitor 16 and it is shown in this drawing, this input signal has become sine wave-like, and only a predetermined phase progresses according to the output frequency (hall device output frequency) of the differential amplifier 4 by the phase lead network 102. Drawing 2 shows the frequency of a phase lead network 102, and the relation of a phase, and the constant of resistance 14 and 15 and a capacitor 16 is set up so that a phase-lead-lag-network angle may serve as peak value this side like the (j) point with a nominal speed. The zero cross comparator 103 consists of an operational amplifier 20, the resistance 17 and 18 for reference voltages, and the resistance 19 for hystereses. Reference voltage decides to become the amplitude center voltage of the output of a phase lead network 102 with the partial pressure of resistance 17 and 18. Thereby, since the output of a phase lead network 102 is changed in the shape of a pulse at the center of an amplitude, it is called a zero cross comparator. The reason changed into a pulse by the zero cross is because it is possible that the output of a phase lead network 102 changes with the temperature characteristic of a hall device, circuit variation, etc. A logical circuit 104 compares one side of the energization command signal of the distribution circuit 5 with the signal of the zero cross comparator 103 by the coincidence circuit, and when both are not in agreement, it generates a high-level signal pulse. The signal pulse is called an interception pulse below. A switching circuit 105 consists of transistors 21 and 22 and resistance 23 and 24, and intercepts energization of transistors 8 and 9 by the interception pulse generated from a logical circuit 104.

[0007] Drawing 3 is a timing chart of operation by this invention. In this drawing, (b) is [the output of a phase lead network 102 and (L of the output of the differential amplifier 4 and (k))] the outputs of the zero cross comparator 103. (m) becomes one side of the energization command signal of the distribution circuit 5 with the output of a logical circuit 104, and (n) becomes the interception pulse of the energization last stage. (p1) And (p2) it synchronizes with one signal of the distribution circuit 5 which is energization current of the motor coils 10 and 11, respectively, among those (p1) is shown in a standup at (m), and before energization current becomes large at falling, it synchronizes with the signal of a logical circuit 104 shown in (n), and is intercepted. Thus, the energization last stage of the motor coils 10 and 11 is intercepted, and the efficiency of a motor improves by cutting invalid current into torque. (q) And (r) is the collector voltage of the output transistors 8 and 9, respectively, and since the energy which the big current of the energization last stage is intercepted and is accumulated at the motor coils 10 and 11 becomes small, the surge voltage at the time of energization interception is decreasing.

[0008] Here, pulse width change of the interception pulse at the time of rotation going up from during starting to a nominal speed is explained. Since, as for during starting, a rotational frequency rises gradually from zero, the output phase of a phase lead network 102 is the case that frequency is low, in drawing 2 , and there is almost no lead. A phase progresses as a rotational frequency approaches rating, an interception pulse occurs, pulse width becomes large gradually, and a motor energization angle and a corresponding nominal speed are reached. That is, the generating range of the dead point does not become large, either, without intercepting an energization angle for during starting. The timing chart of drawing 4 shows operation of this during starting. In this drawing, the output of the differential amplifier 4 of during starting turns out (t), and on the other hand, (v) is the output of the zero cross comparator 103, (w) is the output of a logical circuit 104, and, as for (u), it turns out [of the energization command signal of the distribution circuit 5] that interception pulse width is increasing with the increase in a rotational frequency. Moreover, according to the effect that the pulse width of an interception pulse changes according to a rotational frequency, to rotational frequency change of the motor by disturbance, if rotation becomes slow, interception pulse width will become narrow, energization current increases, and a motor is accelerated. Moreover, if rotation becomes early, interception pulse width will become large, energization current decreases, a motor is slowing down and a speed-control loop will also be formed. Drawing 5 is a timing chart showing this

state. In this drawing, it is the output of the differential amplifier 4 and (y) is an interception pulse, and (x) shows the case of being early, respectively, when late [a rotational frequency is rating and].

[0009] this invention is not limited to the thing of the above-mentioned example. For example, although the above-mentioned example explained this invention by the case where it applies to DC brushless motor of two phases, it is applicable also to DC brushless motor of a three phase circuit or other polyphases of 5 equality. What is necessary is to prepare three transistors for the switching in three pieces and a switching circuit 105 also in three and an output transistor, respectively, and just to connect the output terminal of the distribution circuit 5 according to the case of two phases of drawing 1 so that it may correspond to star connection or three motor coils of a three phase circuit by which the delta connection was carried out in applying to DC brushless motor of a three phase circuit in that case. Moreover, although the above-mentioned example showed the case where the zero cross comparator 103 was constituted from an operational amplifier 20, resistance 17 and 18 for reference voltages, and hysteresis resistance 19, you may constitute from other logical elements equipped with such a comparison function.

[0010]

[Effect of the Invention] As mentioned above, by the control circuit of the motor of this invention, a phase lead network is used and it has the shell which could be made to carry out adjustable [of the interception pulse width] with a zero cross comparator certainly, and the following outstanding effects.

(1) It can carry out adjustable [of the interrupting time of the energization last stage] automatically from the during starting of a motor to a nominal speed.

(2) Consequently, since a motor can be started smoothly, noise is suppressed, and since the switching pulse at the time of a phase change can be reduced, the efficiency of a motor improves sharply.

(3) Moreover, the control circuit of this invention is simple, has few electronic parts, and has little influence by the temperature change, electronic-parts variation, etc.

(4) Moreover, IC-izing is also possible, and since small and low-cost-ization are also attained, practicality is size as a control circuit of the motor of the various uses required to be contained in the small and compact state besides DC brush loess fan's motor for a drive.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the connection diagram showing the composition of the control circuit of the motor concerning the gestalt of 1 operation of this invention.

[Drawing 2] It is the frequency characteristic view of the phase lead network under composition of this invention.

[Drawing 3] It is a timing chart of operation by the control circuit of this invention.

[Drawing 4] It is the timing chart of the during starting by this invention of operation.
[Drawing 5] It is a timing chart of operation at the time of the motor rotational frequency change by this invention.
[Drawing 6] It is the connection diagram showing the composition of the control circuit of the conventional motor.
[Drawing 7] It is a timing chart of operation by the control circuit of the conventional motor.
[Description of Notations]
3: Magnetic position sensing element
4: Differential amplifier
8 9: Output transistor
10 11: Motor coil
102: Phase lead network
103: Zero cross comparator
104: Logical circuit
105: Switching circuit

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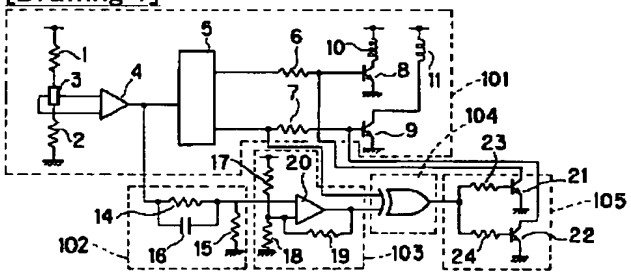
DRAWINGS

[Drawing 1]



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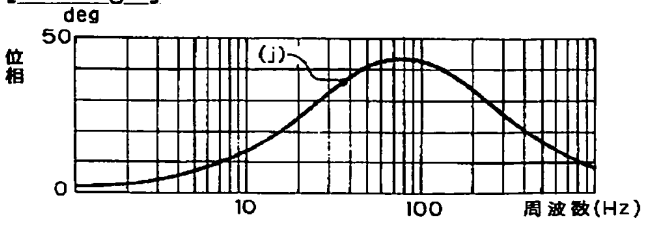
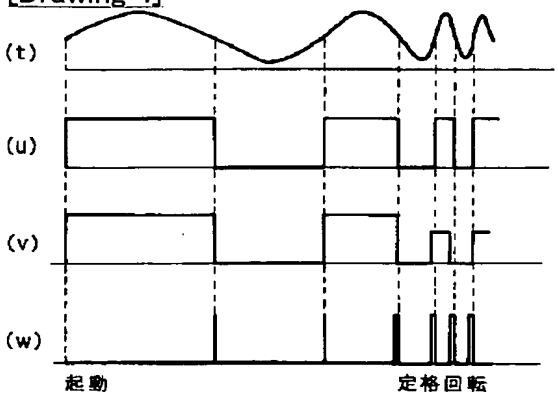
104 : 論理回路
105 : スイッチング回路

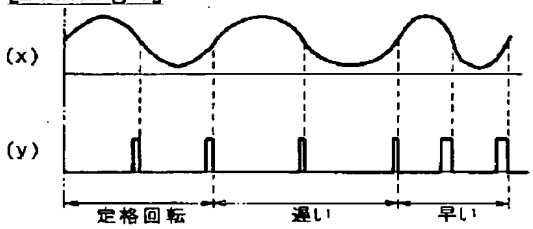
[Drawing 2]



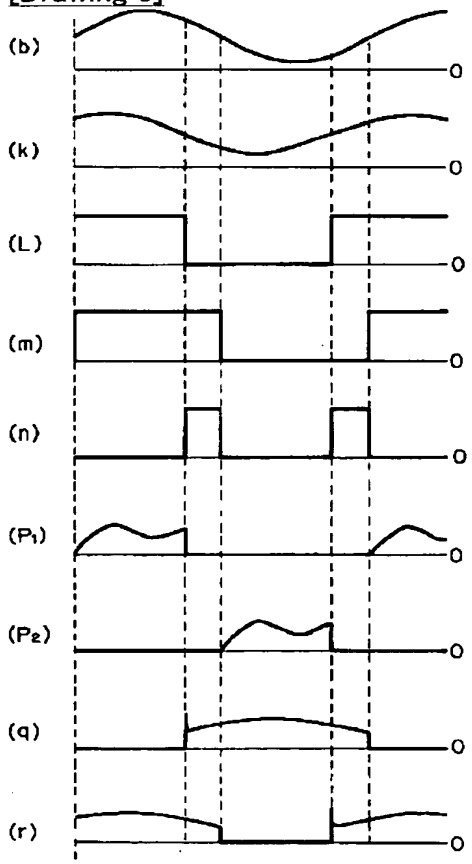
[Drawing 4]



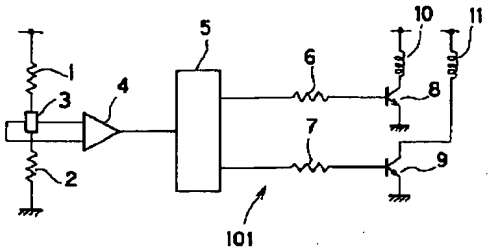
[Drawing 5]



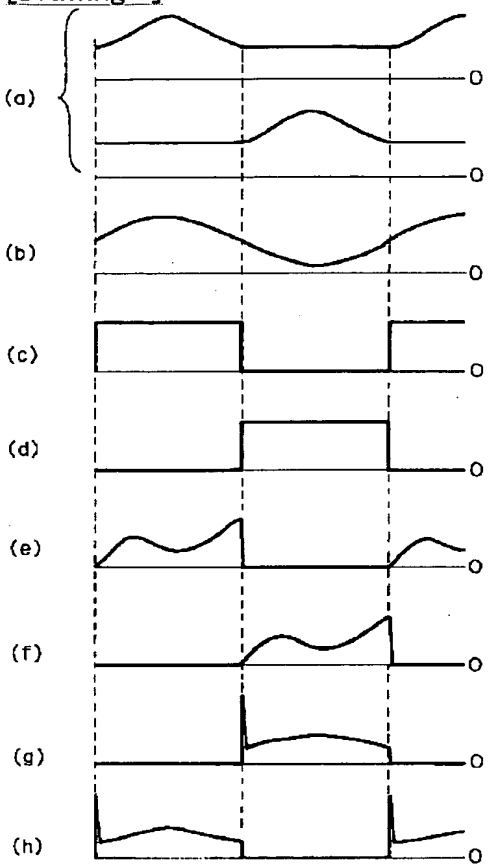
[Drawing 3]



[Drawing 6]



[Drawing 7]



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